INFLUENCE OF BRUSHLANDS ON WHITE-TAILED DEER DIETS IN NORTH-CENTRAL TEXAS

by

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CHAPTER I

INTRODUCTION

The value of wildlife is becoming increasingly important to land managers in Texas because of its system of leased trespass rights for hunting. The white-tailed deer (Odocoileus virginanus) is probably the most important game species in Texas with regards to leasing programs.

Brushy species, such as mesquite (Prosopis glandulosa), occupy a large portion of the rangelands in Texas, Large scale brush control programs have been initiated to reduce this vegetative type to improve grass production for the cattle and sheep industry. These brush control practices directly and indirectly affect the wildlife inhabiting these areas. It is to the rancher's advantage to manage his rangelands from a sound economic view-point and consider the ecological importance of brush and brush control programs on wildlife populations.

The purpose of my study wasi (1) determine the importance of brush and brush dependent species of vegetation in the seasonal diets of white-tailed deer;

(2) evaluate the effect of brush control practices on the dietary habits of the white-tailed deer.

CHAPTER II

REVIEW OF LITERATURE

Many techniques are used to study the food habits of wild animals. Analysis of rumen contents has been one of the most consistently used methods for deer. This method relies on the ability to obtain rumen samples from dead animals. These are readily available during hunting seasons when many deer are killed but are difficult to obtain at other periods of the year,

Aldous and Smith (1938) first investigated the use of stomach material as an indicator of diets, Chamrad and Box (1964) modified the technique to use a point frame, similar to that used in vegetation studies, to aid in identification of material found in deer rumens. Several investigators (Dirschl I962, Korschgen I962, and Martinka 1968) have reported on sampling modifications of the rumen analysis method. Other methods used for diet determination are the fistula techniques (Torell 1954, Heady and Torell 1959, and Lesperance et al. i960), direct observation of tame deer (Reichert 1972) and the microtechnique analysis (Baumgartner and Martin 1939).

The microtechnique for diet determination utilizes microscopic examination of the fecal material. Histological analysis of plant material in feces is made and compared to a reference slide collection of epidermal tissues of plants. The obvious advantage of this method is that the animal need not be destroyed or repeatedly handled to obtain dietary samples, Dusi (1949) gave detailed instructions on reference slide material collection and preparation and showed that "homogeneity existed in a cottontail rabbit fecal pellet so that only a small portion of the pellet need be sampled," Stewart (I967) discussed this technique and presented details on slide preparation, preservation of fecal material, and results of this method,

Storr (1961) found that epidermis from all perennials and a few annual plants passed undigested through the digestive tracts of ruminants, Mulkern and Anderson (1959) used this technique with grasshoppers while Myers and Vaughan (1964) employed it in research on pocket gopher food habits. Several investigators (Hayden I966, Bear and Hansen I966, and Hansen and Flinders I969) used this method for studying jackrabbit food habits, Zyznar and Umess (1969) used this method in dietairy work with mule deer, David (1959)f Croker (1959)i and Brusven and Mulkern (I96O) gave descriptions of epidermal tissue characteristics useful for species identification.

Accurate quantitative data of existing wildlife populations are essential for developing management programs. Population parameters, however, are difficult to obtain due to animal mobility and difficulty of detection. Numerous censusing schemes have been devised to overcome these problems.

Sampling estimates are probably the most widely used method for censusing deer. Several designs have been developed for calculating population densities or numbers, Leopold (1933) described a method developed by R, T. King (unpublished) known as the strip census or "King" method. This design provides density data, Hahn (1948) modified the "King" method for use with deer in the Edwards Plateau region of Texas, The modification was made to cope with problems encountered in heavy brush regions and included the measurement of lateral distances from the transect at which deer could be observed. Lateral distances were averaged and multiplied by transect length to obtain total area censused,

A variation to the Hahn method involves the use of spotlight counts during periods of darkness, Montgomery (1963) reported that deer are most active during the hours of and immediately after sunset. Progulske and Duerre (1964) discussed factors affecting spotlight counts and stated that 82^ of their deer sightings were within five

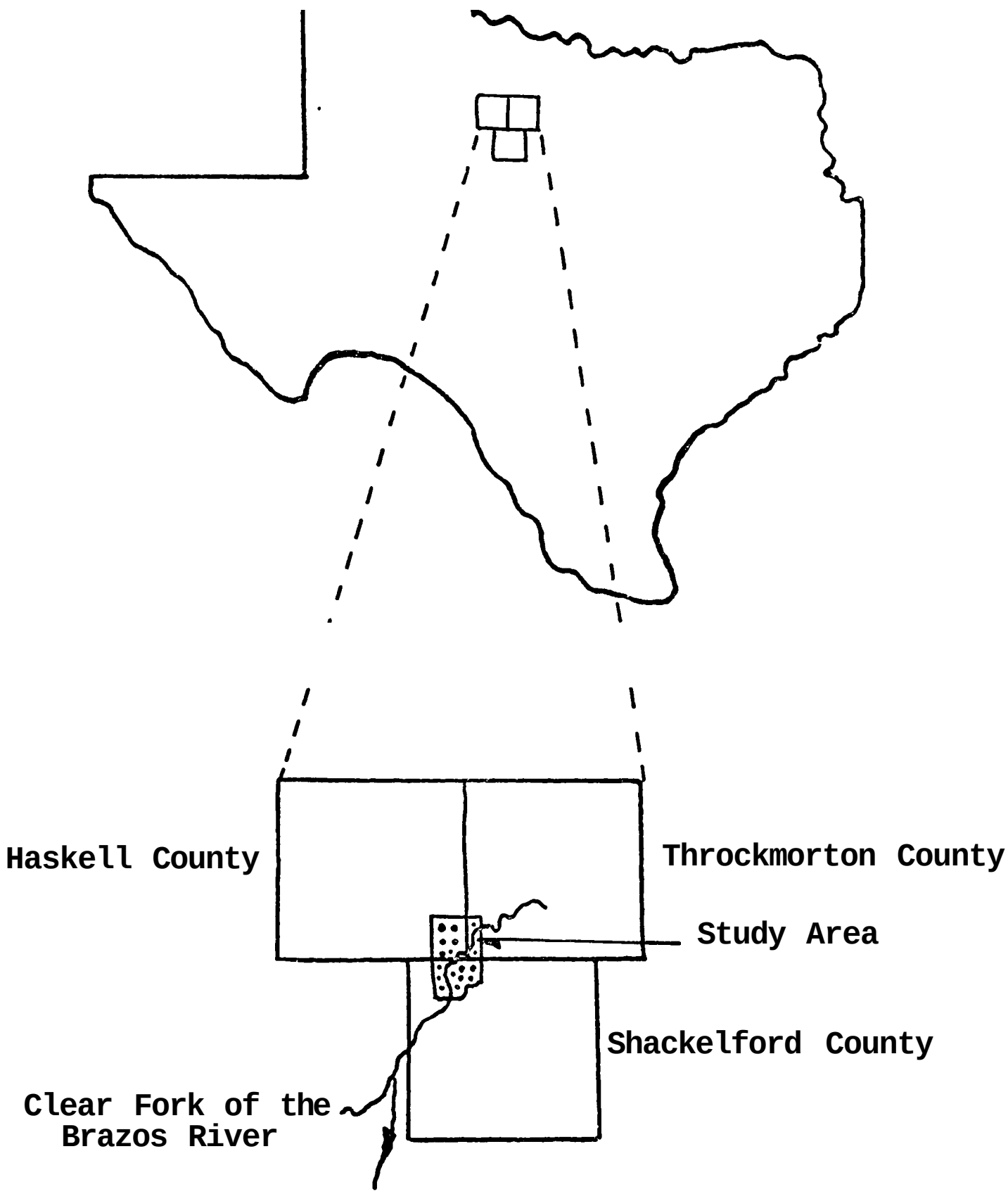
hours after sunset, Darr (1971) also used the spotlight technique to study habitat use by deer.

CHAPTER III

STUDY AREA

The study area was located on contiguous ranches in north-central Texas. The Crooked River Ranch, consisting of 28,031 acres, is located in Haskell, Shackelford, and Throckmorton counties. The 14,000 acre Hendrick's Ranch joining the Crooked River Ranch on the south is located in Shackelford County. The Clear Fork of the Brazos River traverses the Crooked River Ranch from the southwest corner to the northeast corner, separating the ranch into two almost equal halves. The river also traverses the Hendrick's Ranch in a south to north direction separating it into two equal halves. Figure 1 shows location of study area.

Topography varies on both ranches from flat areas on the west side to rugged almost mountainous areas on the east side. All areas along the river are rolling with *large* elevational differences between riverbottom and adjacent ridge tops. Geographical survey maps indicate a relief of nearly 500 feet in some places. The river has formed large, flat flood plains in several areas where it



Fig, 1.—Location of the study area in Texas

meanders back and forth. About 22 miles of river occur on the Crooked River Ranch and some seven miles on the Hendrick's Ranch, Average annual precipitation in the area is 27 inches (Korschgen I967),

Vegetation varies with proximity to the river. The riverbottoms have large hardwood trees with pecan (Garya illinoinensis) and soapberry (Sapindus saponaria) being abundant. Numerous grasses and forbs grow in the river-bottoms and on the flood plains. Away from the river, the vegetation changes to a mixture of mesquite and grasses, Texas winter grass (Stipa leucotricha), buffalo grass (Buchloe dactyloides). sand dropseed (Sporobulus cryptandrus), slim tridens (Tridens muticus), vine mesquite (Panicum obtusum), sideoats grama (Bouteloua curtipendula), and threeawns (Aristida spp,) are all abundant grass species, Forb species on the study area which are utilized by deer include pelotazo (Abutilon incanum). western ragweed (Ambrosia psilostachya), wine cup (Callirhoe involucrata), spectale pod (Dithyrea wislizenii), prickly pear (Opuntia macrorhiza), spreading sida (Sida filicaulis). and silverleaf nightshade (Solanum elaegnifolium), Browse species include ironwood (Bumelia lanuginosa), mistletoe (Phorodendron villosum), polecat bush (Rhus aromatica). and little-leaf sumac (Rhus roicrophylla), All plant species found on the area are listed in Appendix A,

Abundant wildlife exists on both ranches. These include the white-tailed deer, wild turkey (Meleagris gallopavo), feral hog (Sus scrofa), coyote (Canis latrans), bobcat (Lynx rufus), bobwhite quail (Colinus virginianus), mourning dove (Zenaidura macroura), and numerous other small mammals and birds.

There has been little brush control exercised on the Crooked River Ranch, However, large scale chaining operations were initiated in April, 1973• along upper flood plains of the river. Grubbing of mesquite in the head-quarters pasture (approximately 64o acres) was performed in the winter of 1971-72 to facilitate winter calving. Most of the hillsides support relatively open stands of mesquite. Several livestock ponds are scattered over the ranch. The area is managed for both livestock production and wildlife. Hunting rights are leased and provide substantial economic returns.

Brush has been controlled on large areas of the Hendrick's Ranch through either spraying, chaining, or dozing. Brush on the riverbottom was selectively removed by dozing while the larger mast producing trees were retained. Upland sites have had single to multiple brush control treatments.

My study areas were in the southern pastures of the Crooked River Rsuich and the north, west, and central

pastures of the Hendrick's Ranch, Treatments studied included an untreated upland, untreated riverbottom, and a dozed upland (1972), all on the Crooked River Ranch, A sprayed upland (1964), sprayed-chained (1957) and resprayed (1972) uplajid, and a dozed riverbottom (1964) were located on the Hendrick's Ranch,

CHAPTER IV

METHODS

This study was initiated in October, 1971. and continued through April, 1973. Reference slides of leaves, stems, flowers, and fruits were prepared from over 250 plant species collected for reference. The authority for plant names used was Correll and Johnston (1970),

Vegetation was sampled on each of the six treatments to provide standing crop data. Two 250 m (600 ft) lines were randomly located in each treatment type v/ith a 50 m buffer zone from any untreated area. Four 8 X 15 m intensive sampling units (ISU) were located 35 ni apart on each line. Each ISU was subdivided into four 2 X 15 m belts, which provided sixteen 2 X 15 m belts per line and 32 belts per treatment. These belts were used to obtain tree and shrub frequencies (Figure 2a),

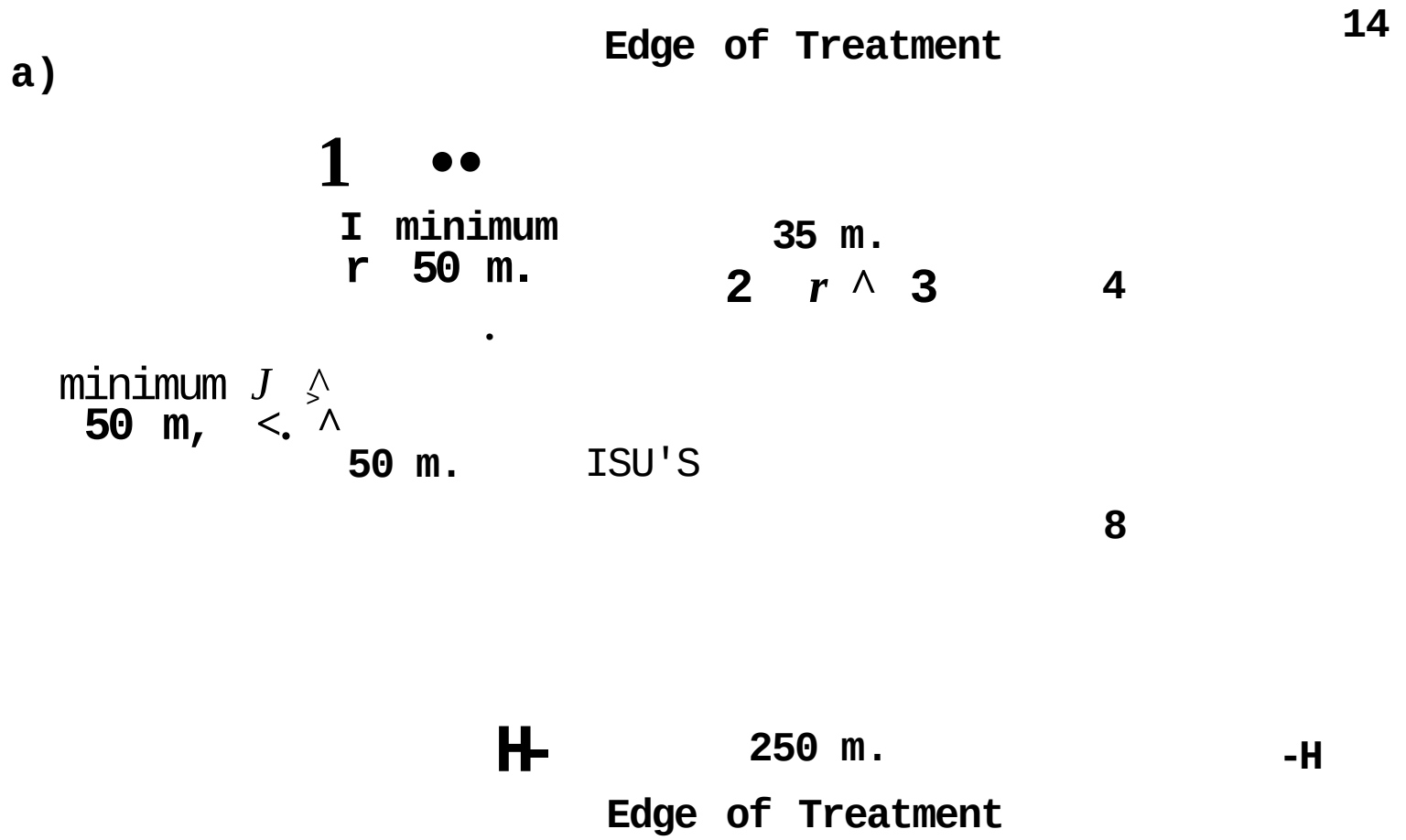
Cover and cover height were obtained by the line intercept method along the two-250 m lines providing 500 m (1200 ft) of line intercept data per treatment. Cover for bare ground, grass *(>75fo* composition), grass-forb mixture (50150 mix), forbs *{'>75%* composition), prickly pear, and

tree and shrub species were recorded in feet of canopy coverage. Height was recorded according to height categories (1, 0 to 6p cm; 2, 6l to 150 cmj 3, 151 to 240 cm; and 4, over 240 cm).

Frequencies of grasses and forbs and brush species (those with less than 5 cm basal diameter, 5 cm above the ground) were recorded in fifteen 30 X 30 cm quadrats placed three to a line in the ISU (Figure 2b), This provided 120 quadrats for evaluation per treatment. Prickly pear was recorded as a forb.

Because of the limited area involved a modification to this design was used for the two riverbottom treatments. Here the two-250 m lines were placed parallel to the river at 35 m intervals instead of randomly located distances from the river.

Deer fecal samples were collected from within the six treatment types. Pellet groups were collected from ISU's when present. Only fresh pellet groups, those with a smooth, glossy surface, were collected in order to provide current information for each period of collection. Approximately 10 pellet groups per treatment were collected during four periods of the year (July 1972, October-November 1972, December-January 1972-73. and April 1973). The number of pellets in each group was recorded to obtain an average number of pellets per group.



Fig, 2,—Field design for vegetation sampling

a) Placement in treatment

b) Design of Intensive Sampling Unit (ISU)

Pellets were oven dried at 70® C for a minimum of three days prior to preparation for microscopic examination. Fecal slides were prepared following the method outlined by Hansen and Flinders (I969). Two slides were prepared from each sample and 10 fields were observed per slide.

Histological features such as size and shape of epidermal trichomes, presence or absence of trichomes, cell shapes, and crystals included in cell walls provided diagnostic characteristics of forb species. Grasses were identified by occurrence and position of specialized epidermal cells such as cork cells, silica cells, silicasuberose couples, and asperites (Hansen and Flinders 1969).

Rumen, cecum, and colon samples were collected from deer harvested during the 1971 and 1972 deer seasons. These samples were prepared for microtechnique analysis in the same manner as fecal samples. Analysis of rumen and colon contents was performed to provide a comparison of vegetative composition in various portions of the digestive tract. A correlation analysis was performed on all species identified in the rumen and colon samples, A Chi-square analysis was performed on each of the major forage species (those with relative frequency ^ *5%)* in the rumen and colon to determine if actual differences in composition existed

between different portions of the digestive tract,

Kulczynski's mathematical expression of similarity (Costing 1956) was used to determine similarity indices between rumen and colon samples, yearly diets of deer on different treatment areas, gind seasonal diets of deer on treated and untreated areas. Kulczynski's similarity index is obtained from the formula1

Where X W t= least amount of an item shared in both diets

A + B = total of items shared in both diets

Two-mile census lines using the Hahn (1948) method were established in each treatment type to determine deer densities. Due to limited size of the treatment areas replications were not possible. The census lines were traversed at dawn and dusk using a pickup truck traveling at 5-8 mph. One observer and the driver located deer along the transect. Data recorded included the time of sighting, mileage, number of animals observed, sex, activity, and atmospheric conditions (Darr 1971). Censuses were conducted during the spring, summer, and fall of 1972, A winter census was cancelled when adverse weather made roads impassible. Spotlight counts were made on the dozed upland throughout the study.

All sightings of deer throughout the study were recorded in field notes as to time, weather, habitat, and activity. The sex and age of animals were recorded where possible. This information was useful in determining reproductive success and fawn survival.

CHAPTER V

RESULTS AND DISCUSSION

Analysis of Vegetation

Vegetation was systematically sampled and classified on each of the six different treatment sites. The following is a summary of the appearance and status of the vegetation on each site.

Untreated Upland (CU)

This habitat type was dominant throughout the Crooked River Ranch. Characteristic vegetation of the area was a relatively open stand of mature mesquite with numerous understory grasses, forbs, and low growing shrubs, Mesquite cover averaged 18^ for all seasons while hackberry (Celtis spp,), ironwood, and catclaw (Acacia spp,) were also present in lesser amounts. Grass was predominant in the understory throughout the year but grass-forb mixtures made up a significant amount (33^) o^ the total cover in the summer. Prickly pear averaged 5^ of the ground cover.

Grasses had a relative frequency of 40^ for the summer, 65^ fall, 64^ winter, and 38% for the spring

(Figure 3), Forb frequencies averaged 50^ in the summer, 35^ fall, 34^ winter, and 59^ in the spring. Year-round shrub and tree frequency was dominated by mesquite (41^). Hackberry, ironwood, and elbowbush (Forestiera pubescens) had frequencies of 18^, 13^, and 7% respectively. Mistletoe had a frequency of 31%.

Untreated Riverbottom (CR)

This habitat was characteristic of the bottomlsmds on the Crooked River Ranch. Vegetation here was characterized by large mast producing hardwood species including pecan, soapberry, and walnut (Juglans spp,). Mesquite was still dominant in the overstory having a total coverage of 50%, Other species were in less abundance with pecans accounting for 6%, soapberry 2%, and walnut 2% of the total cover. Grass was dominant in the understory in winter (88%) and fall {^5%)• Grass-forb mixtures became dominant in the spring and summer, Tasajillo (Opuntia leptocaulis) was the dominant understory shrub with a total cover of 11%,

Grasses were most prevelent in all seasons having an average relative frequency of 5^% (Figure 4), Forbs had a relative frequency of 34%, Tree and shrub frequencies showed mesquite present 55% of the time, ironwood 22%, hackberry 16%, and buckeye (Ungnadia speciosa) 9%. Tasajillo was present 71% of the time. Mistletoe was observed 16% of the time.

y Relative freq. grass

30 X 30 cm quadrats

Relative freq, forbs

Freq, of mesquite
2 X 15 m belts

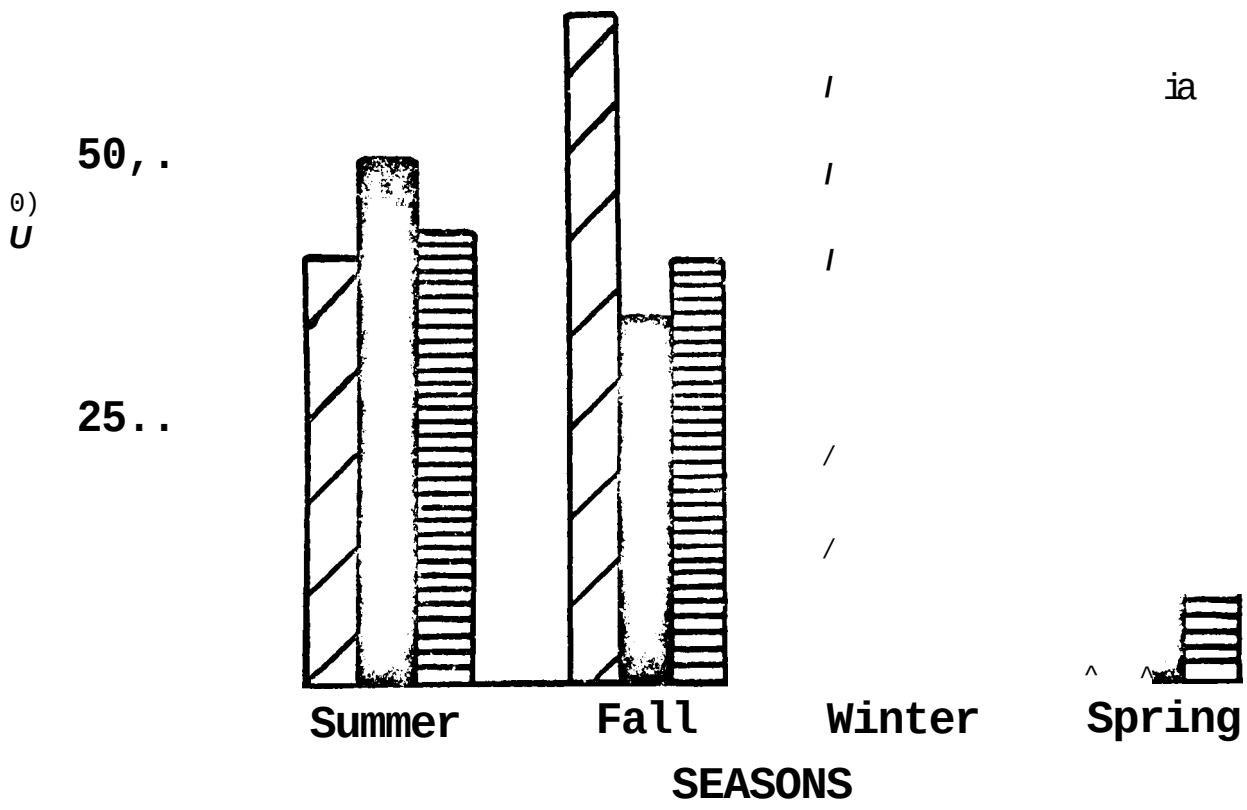
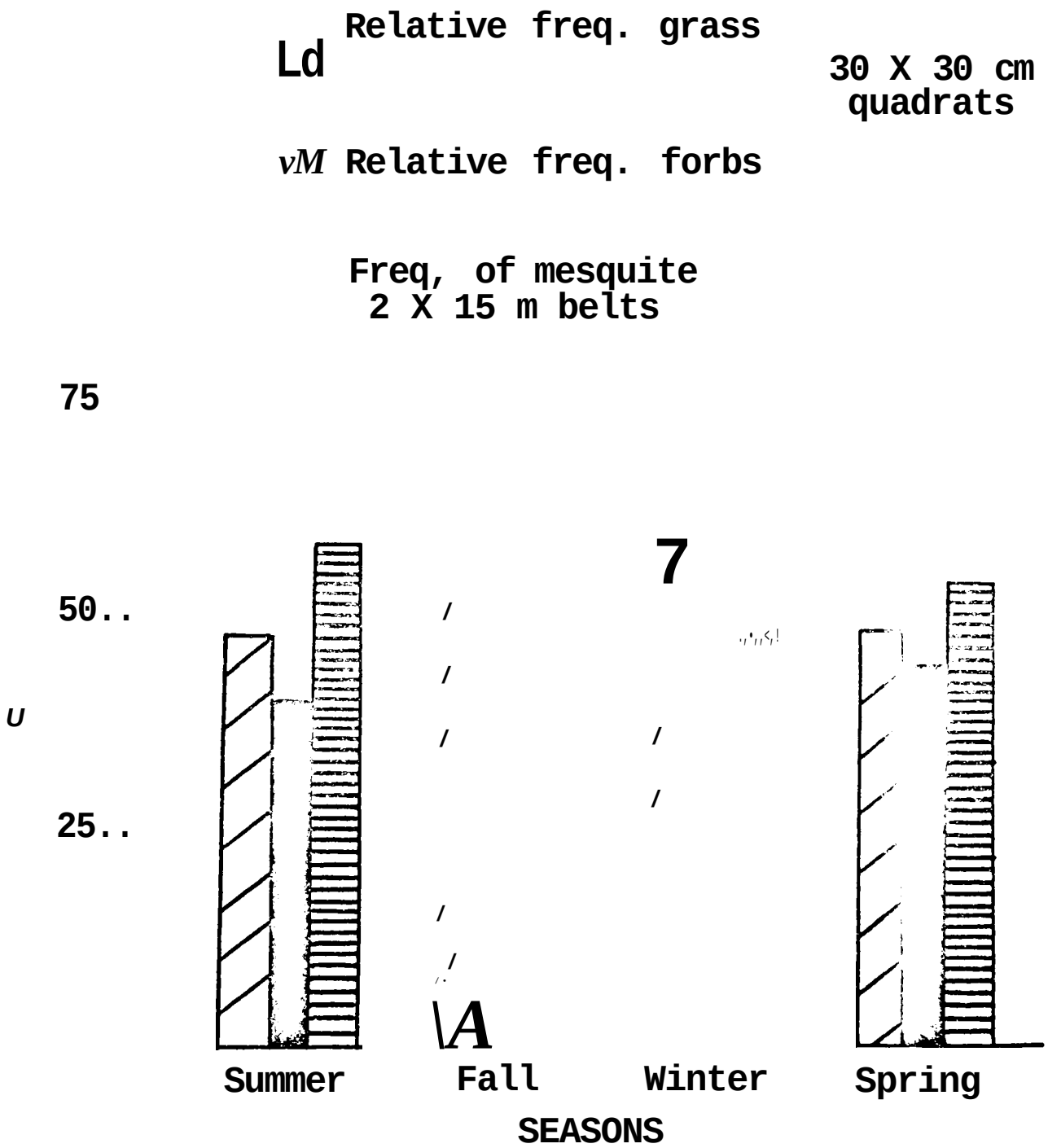


Fig. 3,—Vegetation composition on the untreated upland



Fig, 4,—Vegetation composition on the untreated riverbottom

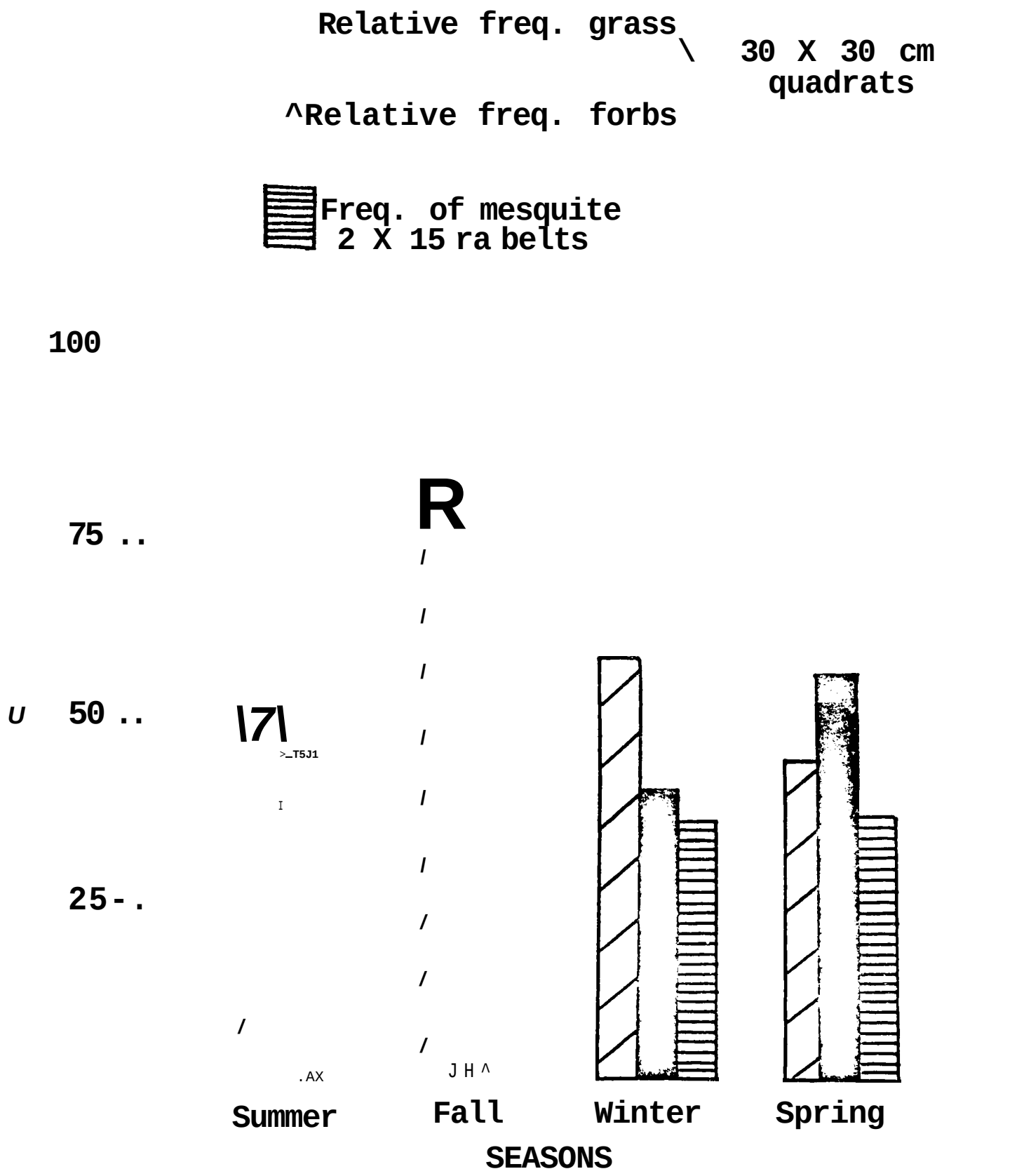
Dozed Riverbottom (DR)

This was the dominant bottomland habitat on the Hendrick's Ranch, Brushy species v/ere selectively removed in 1964 while the large mast producing hardwoods were retained. Line transects showed that mesquite had a cover value of 9%» ironwood 5%, and soapberry 3%. Understory cover fluctuated with seasons, grass being dominant in summer, fall, and winter, while forbs were dominant in the spring.

Frequency data also showed that grasses were most prevelent in the summer, fall, and winter (Figure 5). Forbs dominated in the spring with a relative frequency of 56%, Major tree species present included ironwood with a frequency of 44%, mesquite 32%, and soapberry 16%. Lotebush (Ziziphus obtusifolia) was the predominant understory shrub being present in 32% of the samples. Mistletoe had a frequency of 9%.

Dozed Upland (DU)

The trees and shrubs in this area were dozed out, raked into piles, dried, and burned in 1971 and 1972, Cover data showed grasses to be dominant throughout the year averaging 6l%. Bare ground accounted for 36% of the line intercept in the early summer period following the dozing. Brushy species averaged less than 1% throughout the year. Prickly pear cover was approximately 1%.



Fig, 5.—Vegetation composition on the dozed riverbottom

Vegetation frequency showed forbs were dominant in the spring and early summer while grasses were dominant during the fall and winter (Figure 6), Mesquite was the major brush species with a frequency of 28%, mostly seedlings and resprouts. No mistletoe was found on the area.

Sprayed Upland (SU)

This area received chemical treatment in 1964 and areas similar to this comprised the majority of the Hendrick's Ranch, Most of the treated mesquite had large amounts of basal sprouts. Dead mesquite made up 9% of total cover while live mesquite accounted for about 3%. The herbicide applications were apparently not continuous since many large mesquites remained alive. Grass averaged 6l% of the understory cover in the spring and summer with a grass-forb mixture accounting for 23%. Grass had a coverage of 86% in the fall and winter. Prickly pear cover averaged 8%.

Vegetation frequency showed grass dominant in summer, fall, and winter while forbs were dominant in the spring (Figure 7). Mesquite was the most prevelent tree v/ith a frequency of 38%. Ironwood, catclaw, elbowbush, polecat bush, hackberry, buckeye, and lotebush were also present in frequencies greater than 5%. Mistletoe had a frequency of 19%.

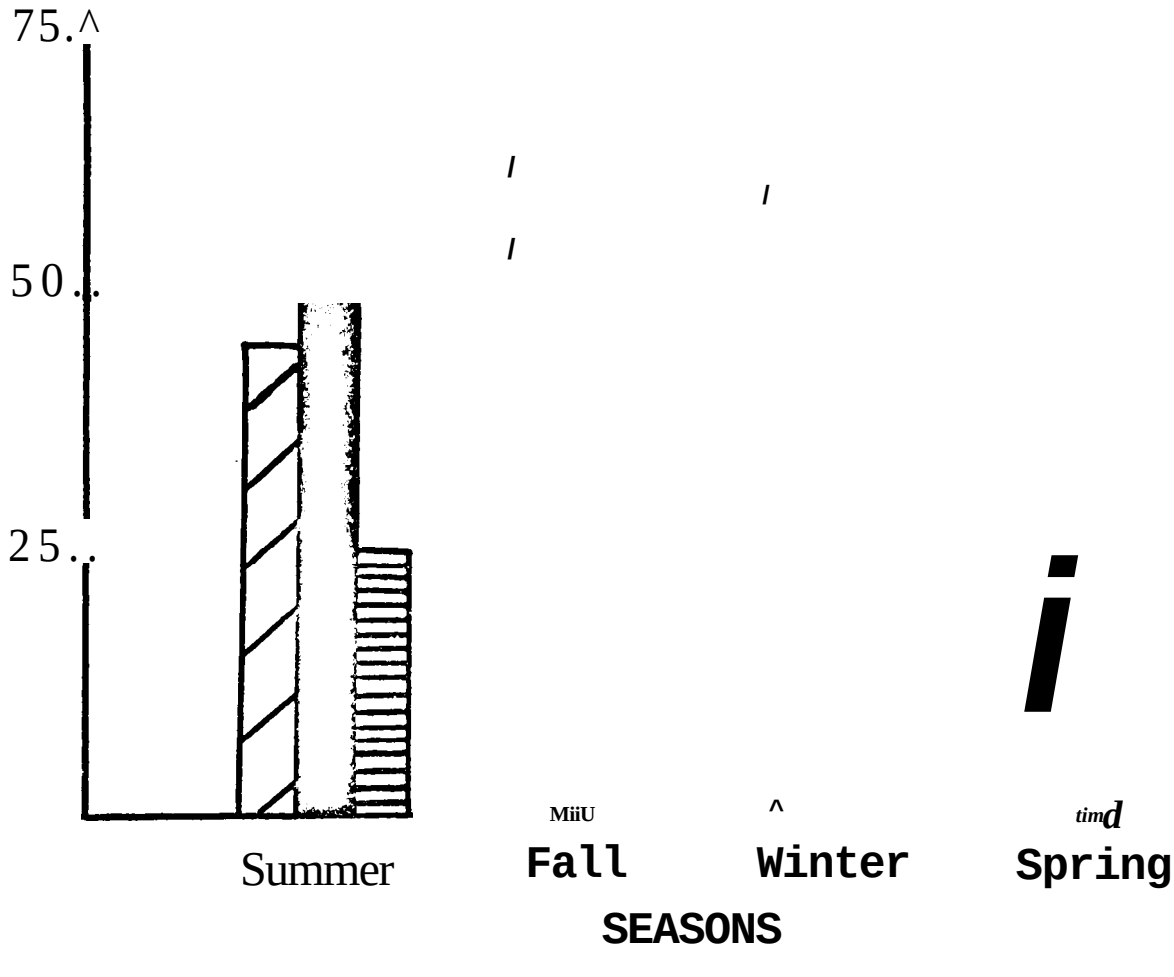


Fig. 6,—Vegetation composition on the dozed upland

Relative freq. grass

30 X 30 cm quadrats

Relative freq. forbs

Freq. of mesquite
2 X 15 m belts

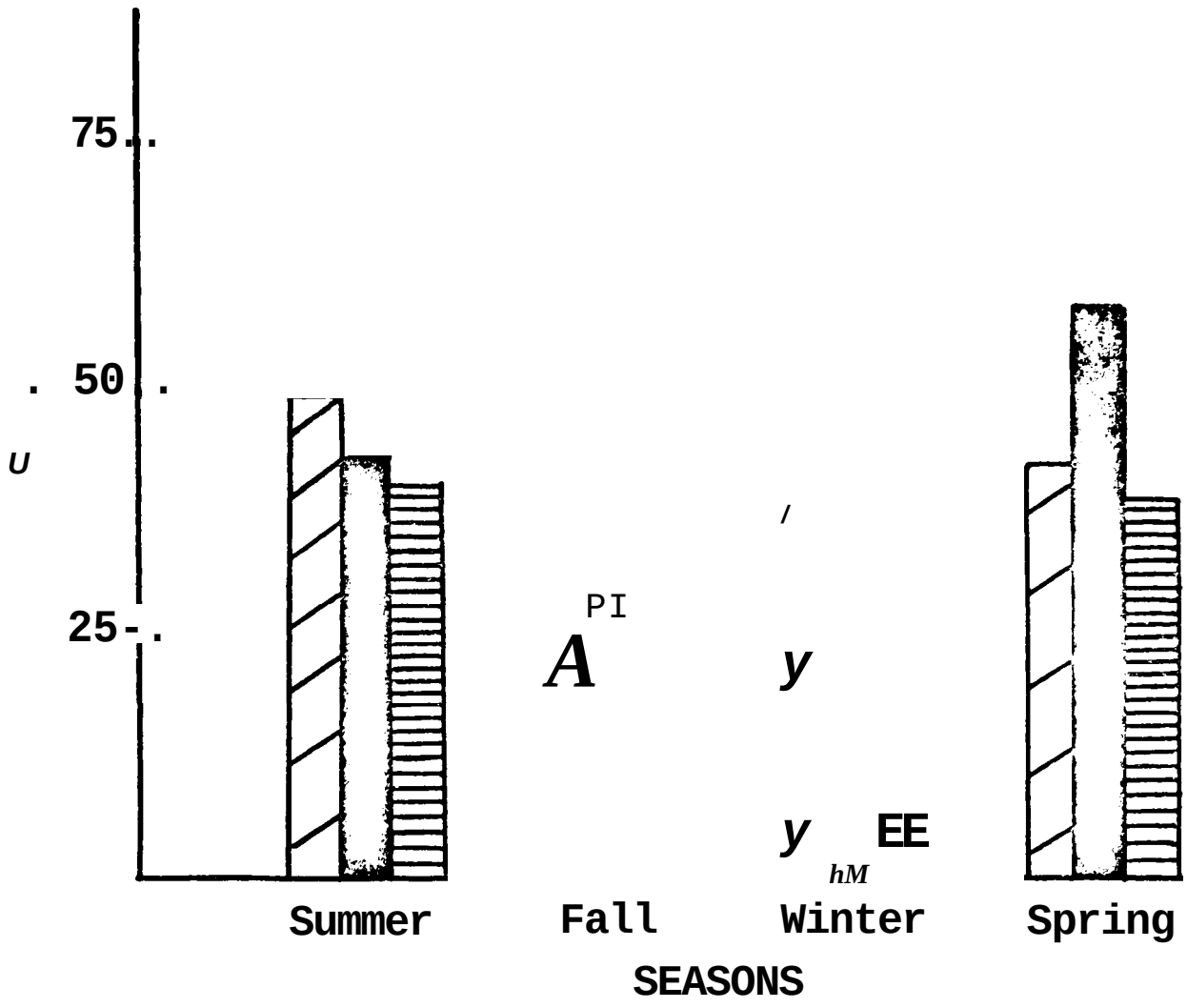


Fig. 7.—Vegetation composition on the sprayed upland

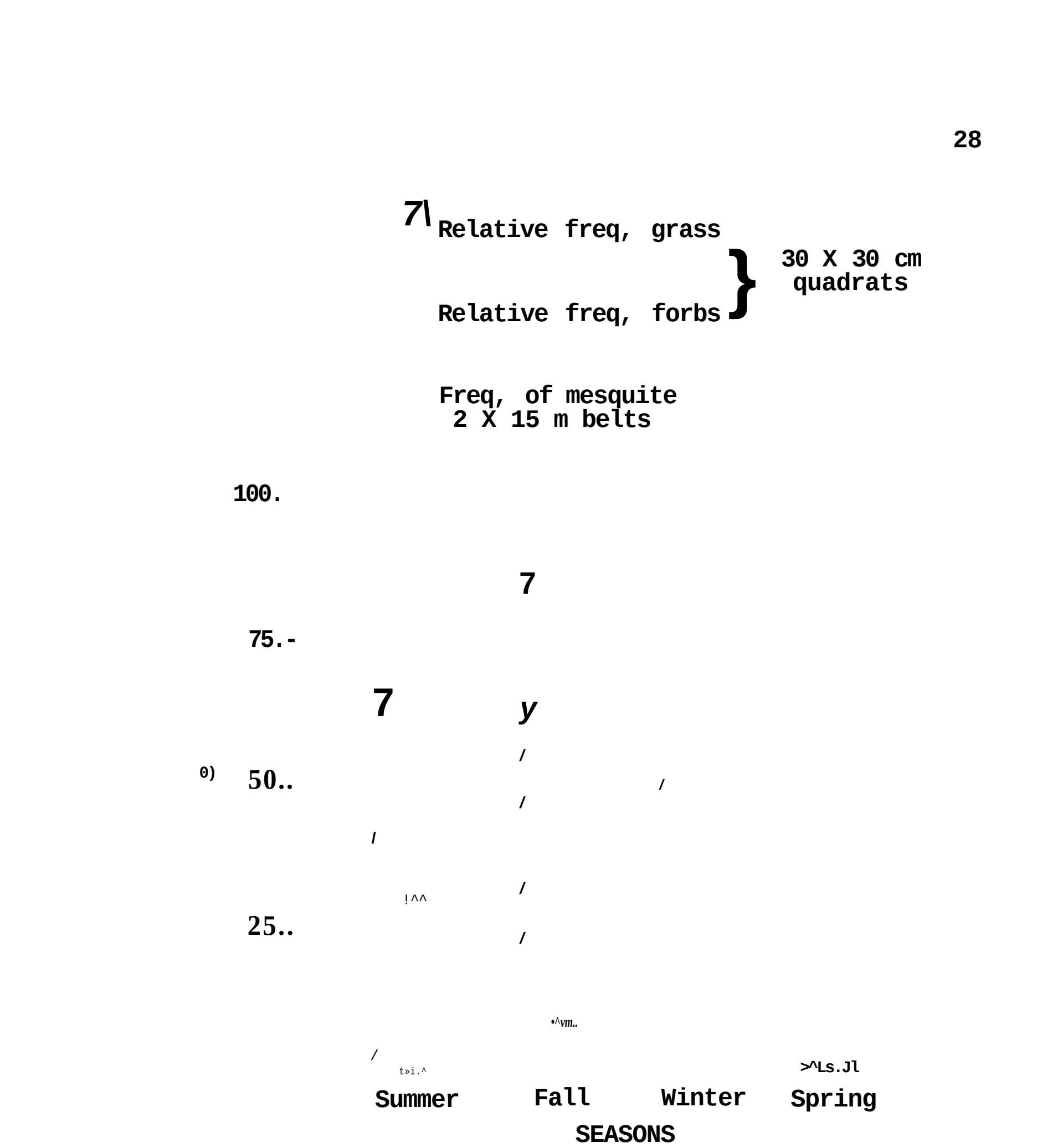
Spraved-Chained-Respraved Upland (S-C-S)

Trees on this area received chemical and mechanical treatment in 1957 and' a second chemical treatment in 1972. Cover consisted primarily of grasses (87%) and a grass-forb mixture (10%) in the spring and summer. The grass-forb mixture was greatly reduced in the fall and winter (3%). Prickly pear had an average cover of 8%. Dead mesquite had a cover value of 2% while live mesquite occupied less than 1% of total cover. Lotebush was the major living brush species with a cover value of 1%.

Frequency data indicated grasses dominate throughout the year (Figure 8). Mesquite had a frequency of 34%, lotebush 28%, and catclaw 19%. Only small individuals of mistletoe (3% frequency) v/ere observed.

Rumen and Colon Dietary Analysis

Samples from the digestive tracts of deer harvested during the 1971 and 1972 hunting seasons were analyzed by the microtechnique to compare species composition in the rumen with that in the colon. All species identified in the rumens and colons are listed in Table 1. Figure 9 shows the major plant species in the rumens and colons. Prickly pear was the dominant item in both sections of the digestive tract with greatest frequencies observed in the rumen samples. Ironwood, mesquite, and mistletoe



Fig, 8.—Vegetation composition on the sprayed-chained- re sprayed upland

TABLE 1

RELATIVE FREQUENCIES OF PLANT SPECIES IDENTIFIED IN WHITE-TAILED DEER RUMEN AND COLON SAMPLES BY THE MICROTECHNIQUE

Scientific Name	Common Name	% Rel, Freq, Rumen	Colon
GRASSES			
Aristida spp,	threeawns	1,05	1.25
Bouteloua spp,	grama grass	1.05	0.75
Buchloe dactyloides	buffalo grass	0.26	0.00
Chloris spp,	windmill grass	0.78	0.50
Eriochloa sericea	Texas cupgrass	0.00	0.75
Panicum spp,		0.26	1.00
Sporobulus cryptandrus	sand dropseed	0.26	0.00
Sorghum spp,		0.26	0.00
Tridens muticus	slim tridens	0,26	0.50
FORBS			
Ambrosia psilostachya	western ragweed	0.00	0.25
Chamaesaracha coniodes	false nightshade	2.09	2.01
P'ithyrea wislizenii	spectacle pod	0.26	0.75
Opuntia macrorhiza	prickly pear	33.59	25.18
Sida fTlicaulis	spreading sida	1.31	0.00
**Solanum elaegnifolium	silverleaf nightshade		20.15
**Solanum spp,		2.09	0.00
Xanthocephalum dracunculoides	annual broomweed	0.26	0.50
BROWSE			
Bumelia languinosa	ironwood	16,53	15.36
Garya illinoinensis	pecan	0.52	0.25
Phoradendron villosum	mistletoe	9.44	9.31
Prosopis glandulosa	mesquite	15.48	17.12
**Rhus aromatica	polecat bush	5.51	0,25
Ungnadia speciosa	Mexican budkeye	0.52	1,76
Ziziphus obtusifolia	lotebush	0.26	0,00

** Indicates a significant Chi-square value

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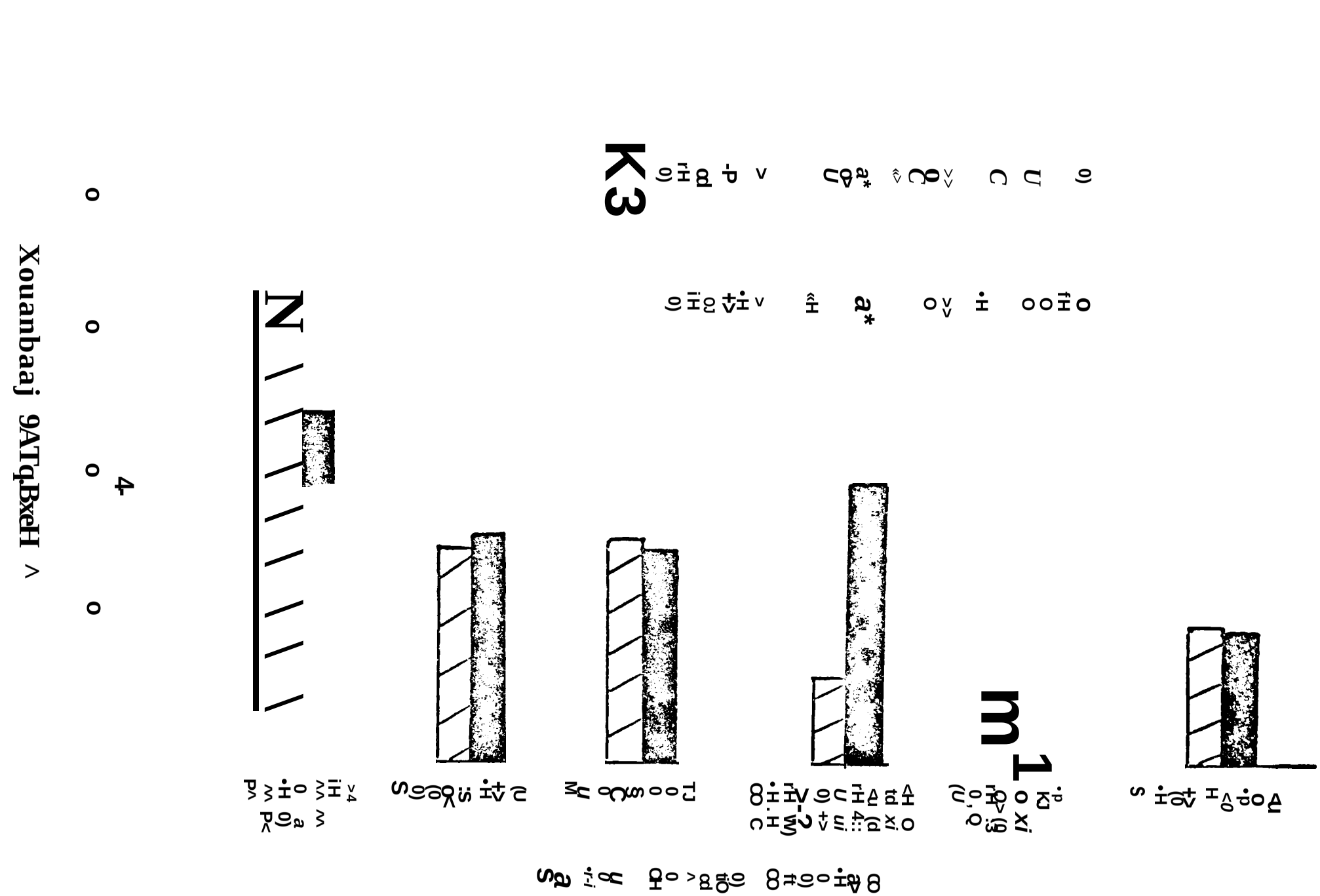

Fig, 9.—Comparis[illegible] tailed deer harvested [illegible]

fragments appeared in nearly equal portions within the rumens and colons, Silverleaf nightshade had a greater frequency in the colon samples. All items identified in the different portions of the gastrointestinal tracts were significantly correlated (r = 0,89).

In comparisons of the rumen contents with lower digestive tract contents, the time factor for food passage through the system must be considered since it may cause differences in frequencies of species identified. Zyznar and Umess (I969) reported that the normal time lapse for food passage in deer was about 36 hours. Differences can also be attributed to the nomadic nature of the animals, as they wander through different vegetative types they may forage on species which were not taken earlier. Differential digestion can also affect the percentages of material identified in various portions of the digestive tract. This may account for differences noted in silverleaf nightshade and polecat bush, Chi-square analyses of these items showed significant differences between rumen and colon contents at the 0.01 level.-/ A comparison of the major species in the rumen and colon (those with relative frequencies ^ *5%)* gave a similarity index of 85^,

=/^X$ for silverleaf nightshade rumen-colon samples =2 28.8. X for polecat bush rumen-colon samples = 18.8. X ,01, 1 d.f. = 6.63.

Several items appeared in the rumen samples but not in the colon samples. Of these items, only material identified as Solanum spp. differed enough to provide significant Chi-square results. This material may have been ingested only a short while before the animal was harvested so that it did not have time to pass through the digestive tract. Results of this analysis indicate that the microtechnique does account for the major food items in the diet.

Deer Diets by Fecal Analysis

Pellet groups collected from the treatment areas averaged 88 pellets per group. Combining all samples for a composite yearly diet indicated that mistletoe was most often consumed by deer with a relative frequency of 28^. The relative frequencies of other major forage items included prickly pear (22^), ironwood *(9%)*, pelotazo (6%), spreading sida (5^), polecat bush *Wo) t* silverleaf night-shade (4^), and mesquite (4^). Browse species comprised 48^, forbs 50^, and grasses *Z%* of the yearly diets for all areas. This differs from deer diets reported in south Texas (Chamrad and Box I968) where forbs accounted for almost 70% of the winter-spring diet. In northern areas browse appears to be the primary food (Allen I968). Dietary information obtained in this study indicates a transition in deer diets between northern and southern areas.

Ten species comprised the major food items in the yearly diets although their percentages varied somewhat between the different treatments. General trends indicated that in untreated areas, mistletoe and shrubby species comprised the bulk of the diet. In the treated areas mistletoe usage declined and forb usage increased, especially the use of prickly pear. Decreased mistletoe use was probably the result of its reduced presence. Exceptions were noted in the dozed riverbottom and sprayed upland areas, both of which retained some larger tree species which were capable of supporting mistletoe. Mistletoe appeared to be a preferred food item since deer selected it when it was available. When mistletoe was less abundant, a shift to increased prickly pear use occurred. Urness (I969) stated that mistletoe has a high forage value, is rich in carbohydrates, has high digestibility, and has small seasonal fluctuations in nutrient content; it appears to serve as an energy-rich concentrate feed in the winter.

On the untreated riverbottom, browse species comprised *67%*, forbs 32^, and grasses *1%* of the yearly diet. Diets computed for the dozed riverbottom showed tree and shrub species providing *S9%»* forbs 37^t and grasses 3% of the forage. The similarity index between diets from the two areas was 68^. Mistletoe was the major food item in deer

diets for both areas with an increase in the use of iron-wood and prickly pear on the dozed riverbottom.

White-tailed deer diets from the untreated upland area consisted of 52% tree and shrub species, 45% forbs, and 1% grasses. Deer diets from the sprayed upland site were similar with 56% tree and shrub species, 43% forbs, and *1%* grasses. The similarity index betv/een these two treatments was *6S%^* The major differences here were related to consumption of mistletoe and prickly pear, both taJcen in greater frequency on the sprayed upland.

The most noticable dietary shifts were observed on the two upland sites which received extensive control programs to completely remove all brushy species. The sprayed-chained-resprayed upland provided a yearly diet consisting of 16% tree and shrub species, 82% forbs, and 2% grasses. This shift in diet was expected owing to limited availa-bility of live browse material. Here prickly pear and silverleaf nightshade comprised the bulk of the diet. A similarity index value of 26.1% existed between the sprayed-chained-resprayed upland and the untreated upland, the lowest index figure for any of the treatment combinations.

The dozed upland showed results more similar to the sprayed-chained-resprayed upland. The yearly diet consisted of 32% browse species, *66%* forbs, and 2% grasses.

The similarity index between the untreated upland and the dozed upland was 59%. An increase in mistletoe usage was noted in the dozed area; this was probably due to the proximity of brushy pastures adjacent to the area. Deer would use these brushy areas for escape and resting cover during the day. Foraging on the dozed area was primarily during the hours of darkness,

A complete listing of the major forage species in each treatment and their relative frequencies in the yearly diets is tabulated in Table 2,

Comparisons of forage usage during the different seasons were made after grouping the data into treated and untreated samples. Similarity indices were determined for diets from the treated versus untreated areas for each season. Indices showed diets were 52% similar in summer and *66fo* similar in the fall. Mistletoe had a greater frequency in the diets from the untreated areas during all seasons except the fall.~ Prickly pear consistently had a greater frequency of use during all seasons in the treated areas. The ten major forage species and their relative frequencies of occurrence in white-tailed deer diets for each season are shown in Table 3.

These data indicate tree and shrub species are utilized throughout the year while most forbs are consumed seasonally, probably when they are most prevelent.

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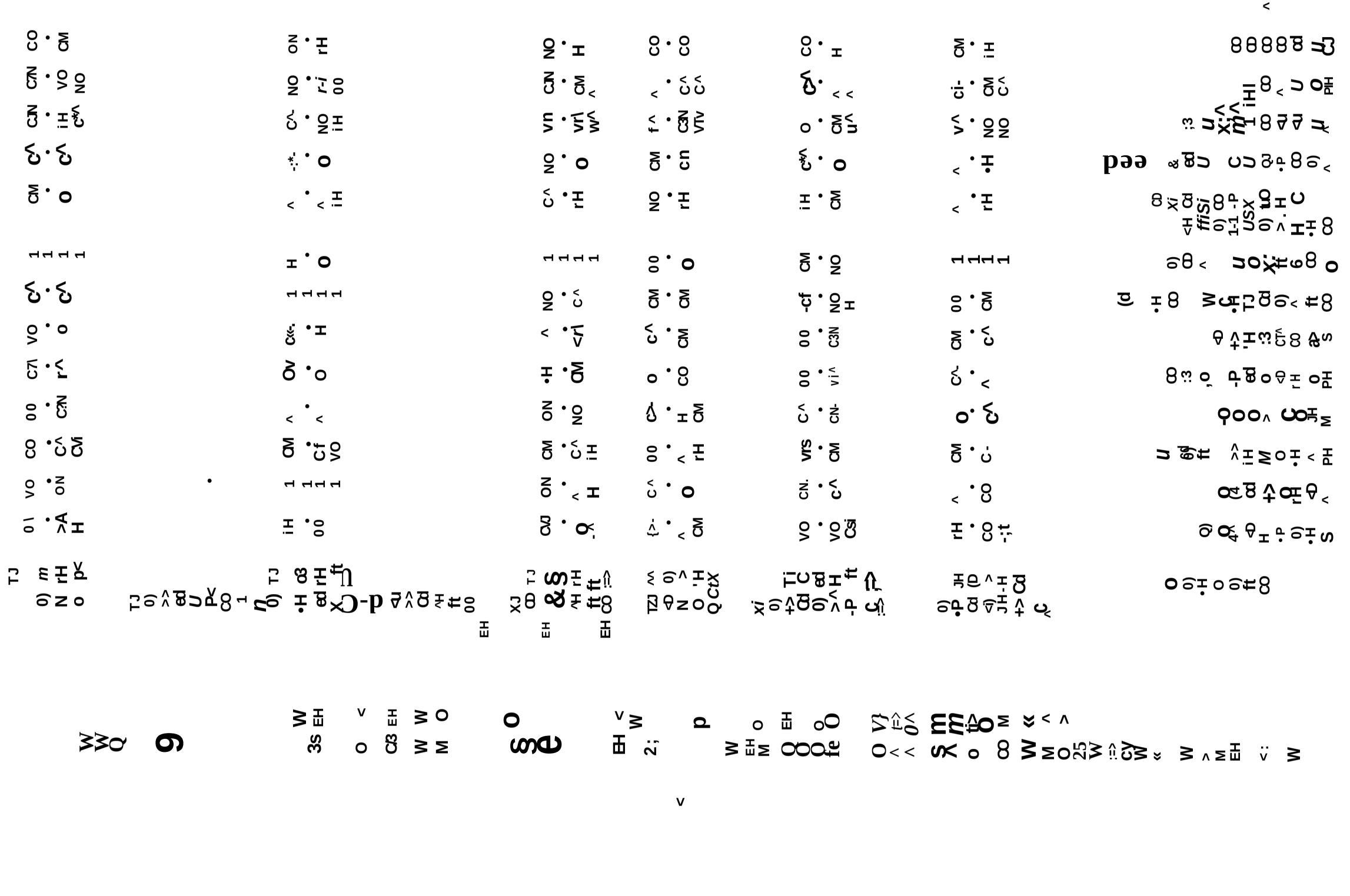
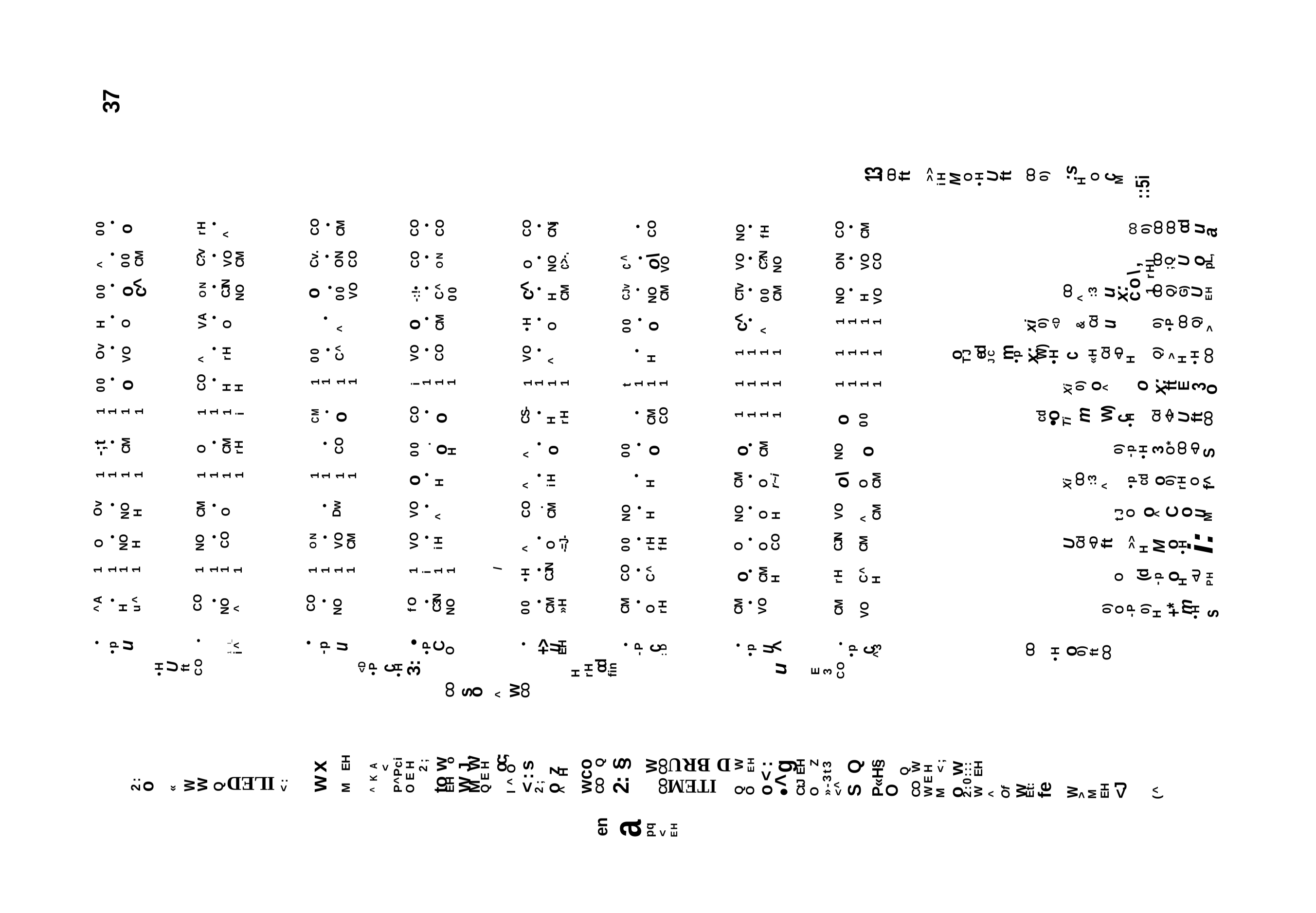


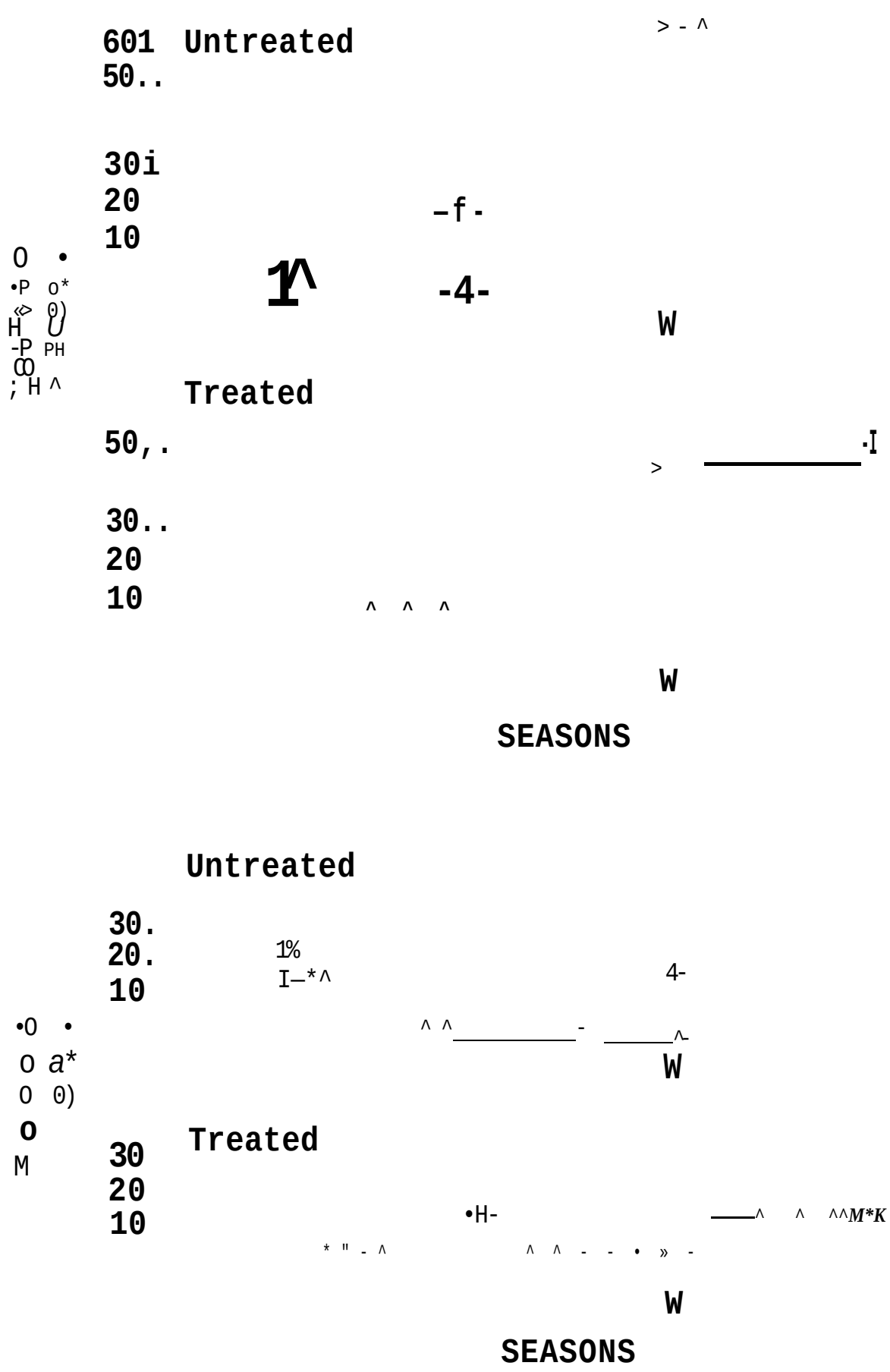


Comparison of Forage Species in Deer Diets and Habitat

Graphical representation of the major food items in the diets of white-tailed deer and their presence in the habitat are depicted in Figure 10. Mistletoe presence in the habitat remained constant throughout the year in both the treated and untreated areas while its usage by deer showed seasonal fluctuations. The usage curves between treated and untreated areas, however, are quite similar. Usage increased from summer through fall and winter and appeared to peak in late winter and early spring. This peak probably resulted from mistletoe being one of the few green forages available during this time of the year.

The figures for polecat bush, spreading sida, silver-leaf nightshade, and pelotazo show patterns similar to the late winter peak of mistletoe in both diets and habitat for both the treated and untreated areas.

The usage curves of ironwood, mesquite, and prickly pear show differences between treated and untreated areas during the different seasons. The usage of ironwood was similar between treated and untreated sire as during the summer, fall, and winter periods while spring usage differed. During this season ironwood utilization decreased in untreated areas while mesquite usage showed a corresponding increase. This shift might be attributed to



« * « Designates presence in diet

Designates presence in habitat

Fig. 10a.—Major forage species in white-tailed deer diets and habitat on treated and untreated brushlands in north-central Texas (seasonal basis).

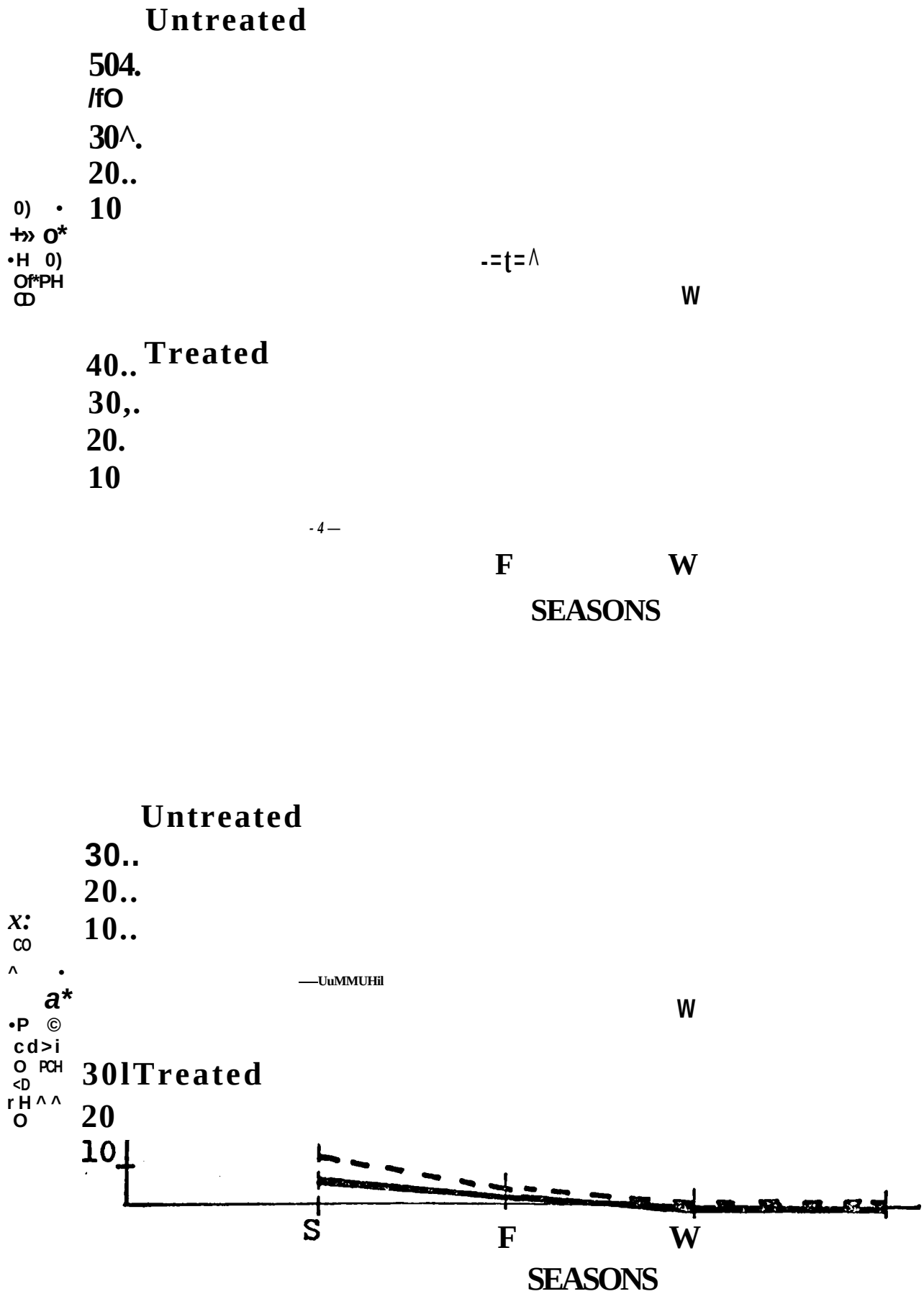
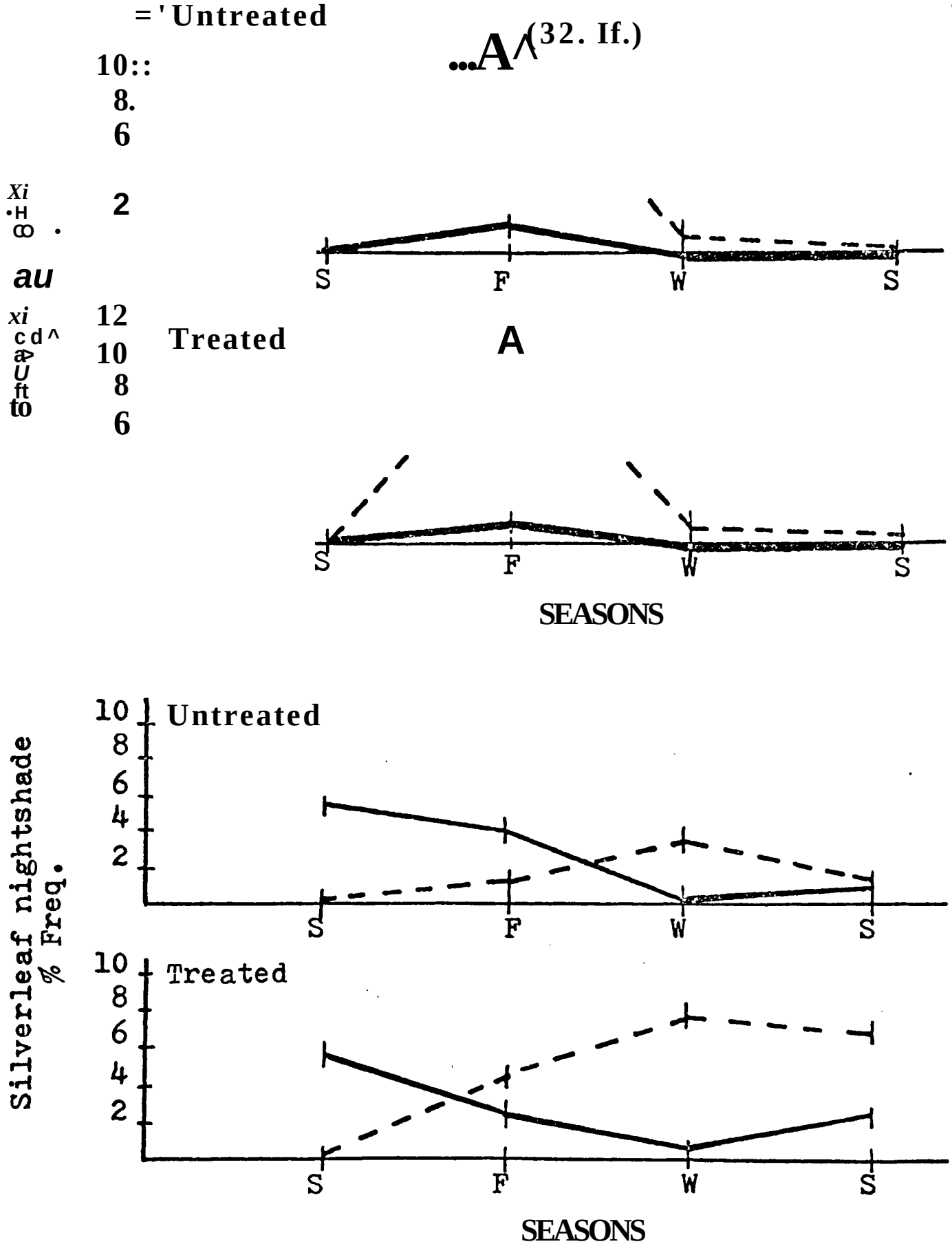


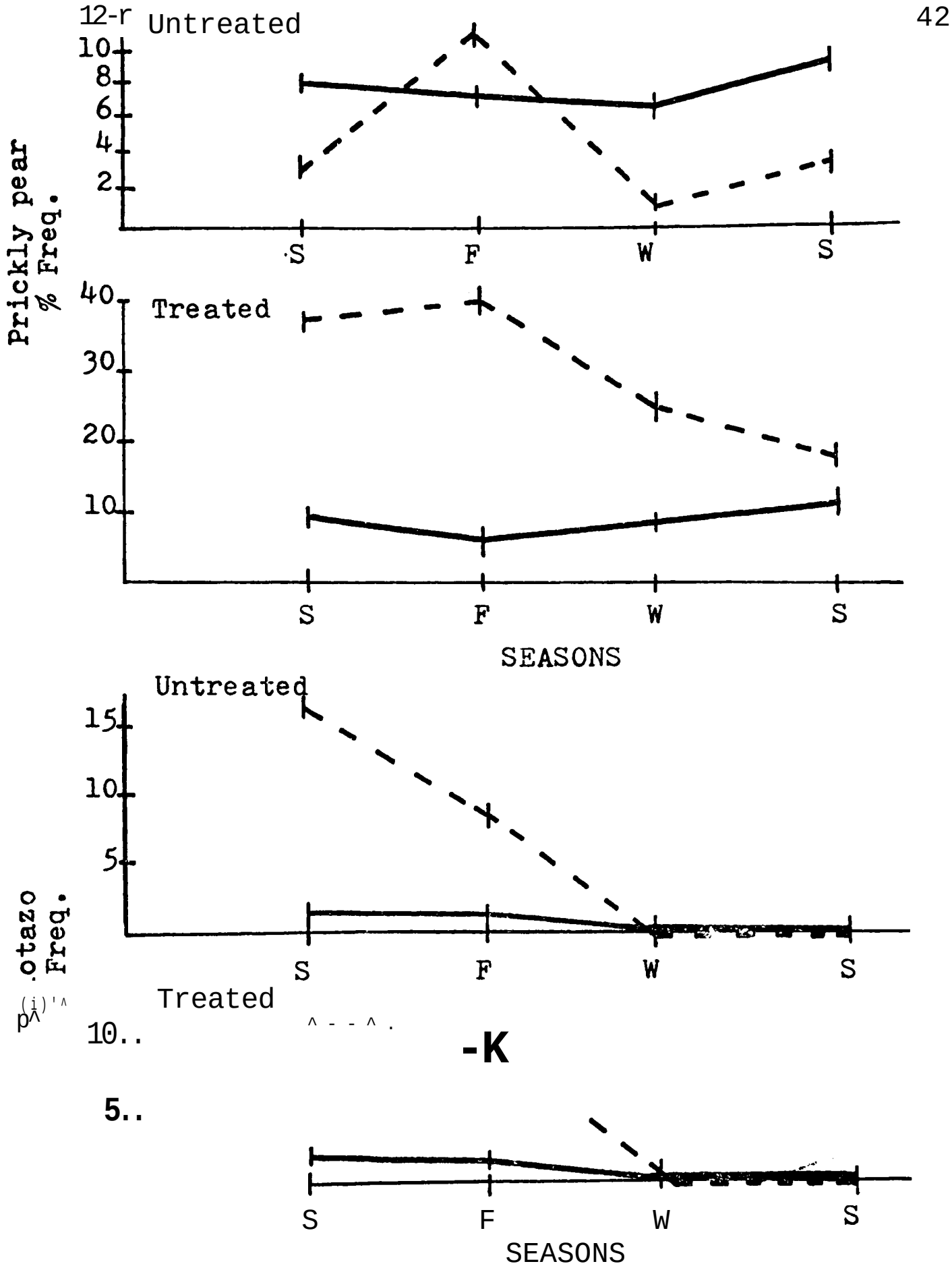
Fig. 10b,—Major forage species in white-tailed deer diets and habitat on treated and untreated brushlands in north-central Texas (seasonal basis).



Designates presence in diet

Designates presence in habitat

Fig. 10c.—Major forage species in white-tailed deer diets and habitat on treated and untreated brushlands in north-central Texas (seasonal basis).



- Designates presence in diet

. Designates presence in habitat

Fig. lOd.—Major forage species in white-tailed deer diets and habitat on treated and untreated brushlands in north-central Texas (seasonal basis).

the early leafing of mesquite, making it a green forage available before other browse,

Ironwood on treated sireas showed a steady usage by deer through the spring season while mesquite usage showed a slight increase. Since mesquite was controlled on the treated areas there was a reduced amount to provide green forage. That which was present and began greening up probably accounted for the slight increase.

Prickly pear use by deer showed some differences in seasonal diets on treated and untreated areas. Its peak use on untreated areas was in the fall. It also had peak usage on the treated areas in the fall but continued as a significant portion of the diet until spring. Decreased spring usage of prickly pear was probably due to increased availability of other green forage.

Population Densities

Cruise lines were censused during three seasons to determine the approximate deer densities in the different treatments. The March, 1972, census was conducted on only the untreated upland, untreated riverbottom, and dozed upland sites. The summer and fall counts were made on all treatments.

Due to the limited size of the treatment areas, replications were not permitted so that confidence

intervals for estimated densities were not calculated. Densities reported, however, are the average from two or more counts on the same transect during the same season. A tally was kept of all animals sited throughout the study, in addition to recording the numbers of deer observed while conducting a census. The daily sighting records showed 157 different encounters for a total of 463 deer. These figures are for the period October, 1971, to November, 1972,

A summary of densities are listed in terms of the number of deer per 100 acres in Table 4, Estimates ranged from 1,05 deer/100 acres on the untreated riverbottom in the fall to 6,80 deer per 100 acres on the dozed river-bottom in the summer.

Census data indicated that riverbottom areas had higher populations during the summer of 1972 than did adjacent uplands. These higher densities might be attributed to the climatic conditions. The summer was extremely dry (U. S. Dept. of Commerce 1972) with a shortage of water in local ponds and the river becoming the focal point for most activity. During the early fall of 1972 abundant rainfall replenished depleted ponds and caused seeps to reappear. A check of deer densities revealed a corresponding decrease in densities of the riverbottom areas while upland site densities increased.

TABLE 4

DENSITY ESTIMATES OF WHITE-TAILED DEER IN TREATED AND UNTREATED BRUSHLANDS OF NORTH-CENTRAL TEXAS (NUMBER OF DEER/IOO ACRES)

Treatments	SEASONS Spring (March, 1972)	Summer (July, 1972)	Fall (Nov., 1972)
Untrt, River	5.55	2.08	1.05
Untrt, Upland	3.28	1.46	3.80
Dozed River		6,80	1.02
Sprayed Upland		1.09	2.77
Sprayed-Chained-Sprayed Upland	«—.-	1.65	3.31
Dozed Upland^/^	1.10	1.46	

=/These figures based on spotlight counts during night period.

This suggests that the animals no longer had to rely on the river as their only source of water.

Dawn and dusk census of the dozed upland showed no deer present. Checks for pellet groups, however, revealed freshly deposited fecal material. Spotlight counts of the treatment confirmed that deer were moving onto the area after sundown. The animals would apparently forage for several hours then bed down until early morning when they foraged for an hour or two before moving to adjacent brushy areas at daylight. This behavior ceased during the fall of 1972 when green vegetation became scarce and a large number of cattle were moved onto the area. No fresh fecal samples were located on the dozed upland for the remainder of the study and frequent spotlight checks of the area indicated no deer usage. Whether or not increased cattle stocking or the vegetational change caused the deer to alter their behavior is unknown.

Reproductive Data

Reproductive success for the 1972 season was tabulated from the daily sighting records. Fifteen sightings of doe and fawn were made between May and November. Data taken while the fawns were still small and easily distinguishable showed nine fawn for 73 doe or an average success of 12.3^, This figure closely approximates a figure of 12.5%

determined by Texas Parks and Wildlife personnel from their Hahn census lines established on the ranch (Vandives, personal communication). These figures are much lower than those reported by Teer (I965). Reasons for a low rate of reproduction are speculative. One theory suggested that a possible high concentration of coyotes in the area might be taking a significant proportion of the fawn crop. Another hypothesis was that screw-worm infestation significantly reduced fawn survival. This second hypothesis might warrant some attention since a large number of screw-worm cases in cattle were treated on the same ranch.

Comparable fawn numbers were observed on both the treated and untreated areas. This suggests that there is probably little difference in overall deer production on untreated areas versus areas having limited brush control.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Comparison of rumen and colon contents showed a correlation coefficient of 0.89, Prickly pear was the dominant item in both sections of the digestive tract. Ironwood, mesquite, and mistletoe fragments appeared in nearly equal proportions within the rumens and colons. Differences in proportions of food items in various parts of the digestive tract can be attributed to nomadic nature of the animals, time lapse of food passage through the animals* systems, and differential digestion.

Microscopic examination of fecal material appeared to provide a good indication of the major forage species consumed by white-tailed deer. When limitations such as time lapse for food digestion and digestibility coeffi-cients are realized the technique can be used with reliability to determine dietary habits.

Results from this research suggest that diets of white-tailed deer on the study area are a transition between those reported from northern and southern sireas. Data showed that browse accounted for more than 50% of the

yearly diets on all treatment areas except tv;o. These two areas had undergone extensive control programs to remove all brush. In both sire as forbs represented a dominant portion of the seasonal diets of deer.

Analysis of the different brush control practices indicated that white-tailed deer are able to cope with limited habitat manipulations which occur under brush control programs. If suitable cover is available, they are able to shift their food habits sufficiently to maintain themselves in a normal manner. This was best demonstrated on the two areas having extensive control measures (the dozed upland and sprayed-chained-resprayed upland). Here deer diets showed a significant switch from browse to forb usage, especially prickly pear.

Problems arising with brush control programs and wildlife management center primarily around cover removal and not forage changes. Deer must have escape and resting cover for suirvival. Indications from this study are that total brush erradication over extensive areas will eliminate deer. Selective control practices or pattern arrangements will allow maintenance of wildlife popula-tions. This fact is also demonstrated by observing utilization of the 1972 dozed upland. Deer used this area at night but returned to brushy cover when frightened or during daylight hours. All sightings of deer on this area

also indicated the animals seldom ventured more than 400 yards from the brushy perimeter. Brushy basal sprouts of mesquite and other browse species on the sprayed-chained-resprayed upland appeared to offer adequate cover for deer. Deer observed on this treatment usually remained on the area but utilized available cover for concealment.

Results of this study strengthen the suggestions for planned brush control programs. Designs that show patch-work arrangements centering around such natural travel ways as ravines, creeks, and gulleys appear most beneficial. These patchwork arrangements increase the amount of "edge" and interspersion of the welfare factors for wildlife.

Since hunting is of prime importance, the design of brush control patterns can also be employed to enhance hunter success and the "total outdoor experience,"

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APPENDIX

A, List of plant species foxmd on the study area

B, List of plant species identified in deer diets by fecal analysis

C, Scientific names of plants listed in Tables and Figures

D, Similarity indices for white-tailed deer yearly diets from different brush control treatment areas, (Expressed as % similarity,)

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APPENDIX At LIST OF PLANT SPECIES FOUND ON THE STUDY AREA

Scientific Name	Common Name
GRASSES	
Agropyron smithii	Western wheatgrass
Andropogon scoparius	Little bluestem
Aristida adscensionis	Six weeks aristida
Aristida purpurea	Purple threeawn
Bothriochloa saccharoides	Silver bluestem
Bouteloua curtipendula	Side-oats grama
Bouteloua gracilis	Blue grama
Bouteloua hirsuta	Hairy grama
Bouteloua rigidiseta	Texas grama
Bromus japonicus	Japanese brome
Bromus unioloides	Rescue grass
Buchloe dactyloides	Buffalo grass
Cenchrus pauciflorus	Grassbur
Chloris cucullata	Hooded windmill grass
Chloris verticillata	Tumble windmill grass
Chloris virgata	Feather fingergrass
Cynodon dactylon	Bermuda
Elymus canadensis	Canada wildrye
Elymus virginicus	Virginia wildrye
Eragrostis curtipedicellata	Gummy lovegrass
Era^rostis me^astachya	Stinkgrass
Eragrostis oxylepis	Red lovegrass
Eriochloa sericea	Texas cupgrass
Krioneuron pilosum	Hairy tridens
Hilaria belangeri	Curly mesquite
Hilaria mutica	Tobosa grass
Hordeum pusillum	Little barley
Tjeptochloa dubia	Green sprangletop

APPENDIX A—Continued

Scientific Name	Common Name
GRASSES	
Leptoloma cognatum	Fall witch grass
Panicum hallii	Halls panicum
Panicum obtusum	Vine mesquite
Panicum oligosanthes	
Panicum ramiseturn	Bristle grass
Paspulum dilatatum	Dallas grass
Phalaris caroliniana	Carolina canary grass
Poa arachnifera	Texas bluegrass
Schedonnardus paniculatus	Texas tumble grass
Setaria macrostachya	Plains bristle grass
Sitanion hystrix	Squirrel-tail barley
Sorghum bicolor	Sorghum
Sorghum halepense	Johnson grass
Sporobulus asper	Tall dropseed
Sporobulus cryptandrus	Sand dropseed
Stipa leucotricha	Texas winter grass
Tridens muticus	Slim tridens
Tridens muticus var elongatus	Rough tridens
Trisetum interruptum	Plains trisetum
FORBS	
Abutilon incanum	Pelotazo
Acacia hirta	Fern acacia
Acalvpha ostryaefolia	Three-seeded mercury
Achillea millefolium	Common yarrow
Allium drummondii	Wild onion
Amaranthus graecizans	Prostrate pigweed
Amaranthus spinosus	Spiny pigweed
Amblvolepis setigera	Huisache-daisy

APPENDIX A—Continued

Scientific Name	Common Name
FORBS	
Ambrosia confertiflora	Ragweed
Ambrosia psilostachya	Western ragweed
Ambrosia trifida	Gisuit ragweed
Ammoselinum popei	Sand parsley
Amsonia ciliata	Blue-star
Aphanostephus skirrhobasis	Arkansas dosedaisy
Argemone polyanthemos	Prickly poppy
Argythamnia mercurialina	Wild mercury
Artemisia ludoviciana	Louisiana sagewort
Asclepias asperula	Spider antelopehorn
Asclepias latifolia	Milkweed
Asclepias oenotheroides	Milkweed
Aster ericoides	
Aster fendleri	
Aster oblongifolius	Aromatic aster
Aster subulatus var ligulatus	
Callirhoe involucrata	Wine cup
Calyophus hartwegii	
Calyophus serrulatus	Yellow evening primrose
Carex brittoniana	
Carex vulpinoidea	
Cassia pumilo	Dwarf senna
Cassia roemeriana	Twoleaf senna
Centaurea americana	Basketflower
Cevallia sinuata	
Chamaesaracha coniodes	False nightshade
Chenopodium fremontii	
Cirsium ochrocentrum	Yellow spine thistle

APPENDIX A—Continued

Scientific Name	Common Name
FORBS	
Cirsium texanum	Texas thistle
Cissus incisa	Marine-ivy
Clematis drummondii	Texas virgins bower
Cocculus carolinus	Red-berried moonseed
Commelina erecta	Erect dayflower
Convolvulus equitans	Bindweed
Conyza canadensis	Horseweed
Cooperia drummondii	Rain lily
Coreopsis grandiflora	Coreopsis
Croton texensis	Texas croton
Cucurbita texana	Texas gourd
Dalea aurea	Golden dalea
Daucus pusillus	RattlesnaJce weed
Delphinium madrense	Larkspur
Desmanthus velutinus	
Dithyrea wislizenii var palmeri	Spectacle pod
Dyschorists linearis	
Echinocactus texensis	Horse crippler
Eleocharis montevidensis	
Engelmannia pinnatifida	Engelmann daisy
Eriogonum longifolium	Wild buckwheat
Erodium texanum	Erodium
Eryngium leavenworthii	Eryngo
Eupatorium rugosum	White snakeroot
Euphorbia albomarginata	
Euphorbia lata	
Euphorbia marginata	Snow-on-the-mountain
Euphorbia nutans	Eyebane

APPENDIX A—Continued

Scientific Name	Common Najne
FORBS	
Euphorbia serpyllifolia	
Euphorbia spathulata	Spurge
Eustoma grandiflorum	Bluebells
Evax prolifera	Rabbits tobacco
Evolvulus nuttallianus	
Evolvulus sericeus	
Fuirena simplex	Umbrella grass
Galium virgatum	Southwest bedstraw
Gaillardia pulchella	Firewheel
Gaillardia suavis	Indian blanket
Gaura coccinea	ScsLrlet gaura
Gaura filiformis	
Gaura suffulta	Wild honeysuckle
Gilia rigidula	
Grindelia squarrosa	Curly-cup gumweed
Hedeoma drummondii	Mock pennyroyal
Hedyotis nigricans	Bluets
Helenium autumnale	Sneezeweed
Helianthus annuus	Common sunflower
Heterotheca canescens	Camphor weed
Hoffmanseggia densiflora	
Hoffmanseggia drepanocarpa	Rush-pea
Hybanthus verticillatus	Green violet
Hymenopappus tenuifolius	Yellow woolywhite
Hymenoxys odorata	Bitterweed
Ibervillea lindheimeri	Globe-berry
Indigofera miniata	Scarlet pea
Juneus torreyi	Rush

APPENDIX A—Continued

Scientific Name	Common Name
FORBS	
Kailstroemia parviflora	
Kochia scoparia	
Krameria lanceolata	Crameria
Lactuca serriola	Prickly-lettuce
Lappula redowskii	Stickseed
Lepidium oblongum	Pepperweed
Lesquerella gordonii	Bladder-pod
Liatris punctata	Gay feather
Limoniuro limabatum	Sea-lavender
Lindheimera texana	Texas yellow star
Linum pratense	Meadow flax
Linum rigidum	
Lygodesmia texana	Skeleton plant
Lythrum californicum	Loosestrife
Matelea biflora	
Melampodium leucanthum	Rock daisy
Mendora heterophylla	
Mentzelia oligosperma	Stickleaf
Mentzelia nuda	Sandlily
Mirabilis linearis	Four o'clock
Monarda pectinata	Plains beebalm
Nama hispidum	
Nothoscordum bivalve	False garlic
Oenothera laciniata	Cutleaf evening primrose
Oenothera triloba	
Opuntia macrorhiza	Prickly pear
Opuntia phaeacantha	Prickly pear
Oxalis dillenii	

APPENDIX A—Continued

Scientific Name	Common Name
FORBS	
Oxalis stricta	Yellow v/ood sorrel
Palafoxia callosa	
Parietaria pensylvanica	Hammerwort
Paronychia jamesii	Whitlow-wort
Penstemon cobaea	Fox-glove
Penstemon fendleri	
Persicaria lapathifolia	Polygonum
Petalestemum candidum oligophyllum	
Phacelia strictiflora	Blue curls
Phyla incisa	Texas frog-fruit
Phyllanthus polygonoides	Leaf flower
Physalis lobata	Purple ground cherry
Physalis viscosa cineraseens	
Pinaropappus roseus	Rock-lettuce
Plantago rhodosperma	Red seeded plantain
Polanisia dodecandra trachysperma	Clammy weed
Proboscidea louisianica	Devils claw
Psilostrophe villosa	Paper flov/er
Ratibida columnaris	Cone flower
Rivina humilis	Pigeon-berry
Rumex crispus	Curly dock
Salsola kali	Russian thistle
Salvia farinacea	Mealy sage
Salvia reflexa	Rocky mountain sage
Salvia texana	Sage
Sarcostemma crispum	Twinevine
Scutellaria wrightii	Skullcap
Sida filicaulis	Spreading sida

APPENDIX A—Continued

Scientific Name	Common Name
FORBS	
Sida physocalvx	
Simsia calva	Bush sunflower
Sisyrinchium ensigerum	Blue-eyed grass
Smilax bona-nox	Cat-brier
Solanum dimidiatum	Western horse-nettle
Solanum elaegnifolium	Silverleaf nightshade
Solanum rostratum	Buffalo bur
Solidago gigantea	Goldenrod
Sonchus asper	Achicoria dulce
Spaeralcea augustifolia	False mallov/
Stillingia texana	Texas stillingia
Talinum aurantiacum	Flame-flower
Teucrium lacinlatum	Germander
Tidestromia lanuginosa	Espanta vaqueros
Tragis nepataefolia	Catnip noseburn
Tribulus terrestris	Mexican sandbur
Triodanis perfoliata	Venus looking glass
Valerianella amarella	Corn salad
Verbena bipinnatifida	Dakota vervain
Verbena halei	Texas vervain
Verbena neomexicana	Hillside vervain
Vernonia marginata	Plains ironweed
Vicia leavenworthii	Vetch
Wissadula holosericea	
Xanthisma texanum	Sleepy daisy
Xanthium strumarium	Cocklebur
Xanthocephalum dracunculoides	Annual broomweed

APPENDIX A—Continued

Scientific Name	Common Name
BRUSH	
Acacia greggii	Catclaw
Acacia wrightii	Catclaw
Aloysia gratissima	White bush
Amorpha fruticosa	Bastard indigo
Artemisia filifolia	Sand sagebrush
Bumelia lanuginosa	Ironwood
Garya illinoinensis	Pecan
Celtis occidentalis	Hackberry
Celtis reticulata	Netleaf hackberry
Cephalanthus occidentalis	Common buttonbush
Crataegus crus-galli	Cockspur hawthorn
Ephedra sp,	Mormon tea
Forestiera pubescens	Elbowbush
Juglans microcarpa	River walnut
Juglans nigra	Black walnut
Mimosa borealis	Pink mimosa
Opuntia leptocaulis	Tasajillo
Phorodendron villosum	Mistletoe
Prosopis glandulosa	Mesquite
Prunus, angustifolia	Chickasaw plum
Rhus aromatica	Polecat bush
Rhus microphylla	Little leaf sumac
Salix nigra	Black willow
Sapindus saponaria	Soapberry
s^chrankia uncinate	Sensitive catclaw
Tamarix gallica	Salt cedar
Ulmus americana	American elm
Un^nadia speciosa	MexicaJi buckeye

APPENDIX A—Continued

Scientific Name	Common Name
BRUSH	
Zanthoxylum clava-herculias	Prickly ash
Ziziphus obtusifolia	Lotebush

APPENDIX B: LIST OF PLANT SPECIES IDENTIFIED IN DEER DIETS BY FECAL ANALYSIS

Scientific Name	Common Name
GRASSES	
Andropogon spp,	Bluestems
Andropogon scoparius	Little bluestem
Aristida spp,	Threeawns
Aristida purpure a	Purple threeawn
Bouteloua spp,	Grama
Bouteloua curtipendula	Sideoats grama
Bouteloua gracilis	Blue grama
Buchloe dactyloides	Buffalo grass
Chloris spp,	Windmill grass
Eragrostis spp,	Lovegrass
Panicum ramisetum	Bristle grass
Sporobulus cryptandrus	Sand dropseed
Stipa leucotricha	Texas wintergrass
Tridens muticus	Slim tridens
FORBS	
Abutilon inc anum	Pelotazo
Allium drummondii	Wild onion
Amblvolepis setigera	Huisache daisy
Ambrosia confertiflora	Ragweed
Ambrosia psilostachya	Western ragweed
AniTTioselinum popei	Sand parsley
Aster spp,	
Hflllirhoe involucrata	Wine cup
Hfllyophus serrulatus	Yellow evening primrose
nhamaesaracha coniodes	False nightshade
Cirsium ochrocentrum	Yellow spine thistle
Desmanthus velutinus	

APPENDIX B—Continued

Scientific Name	Common Name
FORBS	
Dithyrea wislizenii	Spectale pod
Galium virgatum	Southwest bedstraw
Gaura filiformis	
Heterotheca canescens	Cainphor weed
Kochia scoparia	
Lesquerella gordonii	Bladder pod
Oenothera spp.	Primrose
Opuntia macrorhiza	Prickly pear
Oxalis stricta	Yellow wood sorrel
Ratibida columnaris	Cone flower
Sida filicaulis	Spreading sida
Sida physoealyx	
Simsia calva	Bush sunflower
Solanum spp,	
Solanum elaegnifolium	Silverleaf nightshade
Verbena bipinnatifida	Dakota vervain
Xanthocephalum dracunculoides	Annual broomweed
BROWSE	
Acacia greggii	Catclaw
Bumelia lanuginosa	Ironwood
Garya illinoinensis	Pecan
Celtis occidentalis	Hackberry
Julians nigra	Black walnut
Phorodendron villosum	Mistletoe
Prosopis glandulosa	Mesquite
Rhus aromatica	Polecat bush
Rhus microphylla	Little-leaf sumac
Sapindus saponaria	Soapberry

APPENDIX B—Continued

Scientific Name	Common Name
BROWSE	
Ungnadia speciosa	Mexican buckeye
Ziziphus obtusifolia	Lotebush

APPENDIX Ci SCIENTIFIC NAMES OF PLANTS LISTED IN TABLES AND FIGURES

Scientific Name	Symbol	Common Name
Abutilon incanum	Abin	Pelotazo
Ambrosia psilostachya	Amps	Western ragweed
Bumelia lanuginosa	Bula	Ironwood
Heterotheca canescens	Heca	Camphor weed
Opuntia macrorhiza	Opma	Prickly pear
Phorodendron villosum	Phvi	Mistletoe
Prosopis glandulosa	Prgl	Mesquite
Rhus aromatica	Rhar	Polecat bush
Sida filicaulis	Sifi	Spreading sida
Solanum elaegnifolium	Soel	Silverleaf nightshade